

Blunt solid organ injury in adolescents: should they be treated in the pediatric or the adult trauma center?

Lesión de órgano sólido en adolescentes: ¿debe tratarse en el centro de trauma pediátrico o en el de adultos?

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Abstract

P

ediatric multiple trauma (PMT) is a significant cause of morbidity and mortality. Nearly 90% of the patients resulting from road traffic accidents have blunt abdominal-chest trauma, making it the most common form of presentation of PMT. In these patients, blunt solid organ injury (BSOI) is the most common life-threatening condition. The decision to refer to a pediatric trauma center (PTC), mixed trauma center, or adult trauma center is also controversial. In the last decade, there has been ongoing reports of significant variability in mortality rates of PMT according to the nature of the healthcare facilities. While evidence suggests that strictly pediatric patients treated outside of PTC tend to have higher mortality than those treated only within pediatric facilities, evidence regarding adolescents suggests otherwise and should be looked at carefully. The objective of this review is to analyze how the mortality of PMT and BSOI is affected by the type of trauma center facility.

Keywords: Pediatric multiple trauma, blunt solid organ injury, adolescents, pediatric trauma center, adult trauma center.

Resumen

E

l traumatismo múltiple pediátrico (TMP) es una causa importante de morbilidad y mortalidad. Cerca del 90% de los pacientes resultantes de accidentes de tráfico presentan traumatismos abdominales-torácicos cerrados, siendo la forma de presentación más frecuente del TMP. En estos pacientes, la lesión contundente de órganos sólidos (BSOI, por sus siglas en inglés) es la afección potencialmente mortal más común. La decisión de derivar a un centro de trauma pediátrico (CTP), un centro de trauma mixto o un centro de trauma para adultos también es controvertida. En la última década, ha habido informes continuos de una variabilidad significativa en las tasas de mortalidad de TMP según la naturaleza de las instalaciones de atención médica. Si bien la evidencia sugiere que los pacientes estrictamente pediátricos tratados fuera de CTP tienden a tener una mortalidad más alta que los tratados solo dentro de los centros pediátricos, la evidencia con respecto a los adolescentes sugiere lo contrario y debe analizarse con cuidado. El objetivo de esta revisión es analizar cómo la mortalidad de TMP y BSOI se ve afectada por el tipo de instalación del centro de trauma.

Palabras clave: Traumatismo múltiple pediátrico, traumatismo cerrado de órgano sólido, adolescentes, centro de traumatología pediátrica, centro de traumatología de adultos.

According to data from the Centers of Disease Control and Prevention (CDC), all injury-related causes are the most prevalent cause of death in pediatric individuals¹. More specifically, all injury-related causes of death represent over 60% of all the deaths in children and teenagers, only followed by firearm-related injuries. Unintentional motor vehicle crashes were the leading cause of death among all the injury-related mortality causes². Nearly 59% of the pediatric patients admitted to the emergency for MT resulted from road traffic accidents (RTA), particularly in male children, followed by fall injuries which tend to be significantly less severe. Considering the high incidence of pediatric MT (PMT), significant measures need to be implemented to decrease this condition's overall incidence and mortality³.

Evidence states that traumatic brain injury (TBI) was the most common cause of death in PMT, with a median age of 7⁴. Despite TBI being the most common cause of death, it is not the most prevalent type of trauma in PMT. Nearly 90% of the patients resulting from RTA have blunt abdominal-chest trauma, making it the most common form of presentation of PMT. In these patients, blunt solid organ injury (BSOI) is the most common life-threatening condition. Concerning BSOI, half of the individuals developed liver injury, spleen injury was reported in 36%, and renal injury was detected in 17% of the patients⁵. However, data regarding mortality of BSOI in the pediatric population is somewhat controversial. While some studies have reported mortality rates under 1%, most studies from developing countries have reported mortality rates as high as 15%⁶.

Furthermore, there is a gray zone within the pediatric population, teenagers, where the decision to be treated by a pediatrician or an adult physician may be complex⁷. In addition, the decision to refer to a pediatric trauma center (PTC), mixed trauma center (MTC), or adult trauma center (ATC) is also controversial. In the last decade, there has been ongoing reports of significant variability in mortality rates of PMT according to the nature of the healthcare facilities⁸. While evidence suggests that strictly pediatric patients treated outside of PTCs tend to have higher mortality than those treated only within pediatric facilities, evidence regarding adolescents suggests otherwise and should be looked at carefully⁹. The objective of this review is to analyze how the mortality of PMT and BSOI is affected by the type of trauma center facility.

MULTIPLE TRAUMA IN ADOLESCENTS: ARE WE DOING IT WRONG?

PTC were created to improve the overall outcomes of injured children. However, while PTC can uniquely care for pediatric individuals, they are less accessible and numerous than ATC, making them less likely to be the first place of consultation¹⁰. Moreover, available evidence evaluating the impact of PTC in this matter has given conflicting results. For example, a retrospective study analyzed a population of 26,276 pediatric patients with penetrating injuries treated at a PTC (n=3737) or an ATC (22,539). According to the results, children had equivalent survival outcomes, whether treated at PTC or ATC. With the above statement, the need for PTC becomes questionable. However, the same study reported that the younger the patients, the superior the functional outcomes when treated at pediatric facilities¹¹.

Therefore, age stratification is essential, especially for pediatric patients. Other authors have categorized their population into several subpopulations to address this matter, but mainly making a difference between children and teenagers¹². Following these standards, a retrospective cohort study analyzed 175,585 pediatric patients treated at PTC, MTC, and ATC. More importantly, the population was segmented according to age into young children (5 years and younger), older children (6-11 years), and adolescents (12-18 years). Analyses showed that children had higher mortality when treated at ATC or MTC (odds ratio (OR) 1.57 and 1.45, respectively) than those treated at PTC. However, there was no association between center type and mortality among older children or adolescents. In conclusion, child mortality is affected by the type of trauma center, especially in younger children, but these associations are less significant in older children and adolescents¹³.

In light of the above, it is plausible that the benefits from a specific center type differ from another just by the patient's age. For instance, it is almost contradictory to believe that a center with expertise available for infant care has the resources to manage an older adolescent¹⁴. Therefore, it has been hypothesized that the association between trauma center type and mortality differs only across clinically relevant age strata, namely children and adolescents¹³. On the other hand, Evans et al.⁸ performed a retrospective study that included over 21,000 cases that met inclusion criteria. Trauma-induced mortality rates in adolescents were the lowest at PTC with 2.5%, and the highest at ATC with 4.9%. After logistic regression accounting for injury severity, mechanism of injury, and physiological parameters, the adjusted OR for MTC and ATC were 1.85 and 2.41, respectively. Consequently, the authors suggested quality improvement initiatives for ATC and MTC required to provide optimal care to injured children.

On the other hand, a more recent investigation analyzed over 10,000 children treated at PTC and ATC. After adjusting for confounders on multivariate analysis,

children under 14 years had lower in-hospital mortality rates at PTC than those treated at ATC. However, there was no difference in adolescent mortality rates across different trauma centers. The authors concluded that young children, not adolescents, have better survival rates at PTC¹⁵. Conversely, Walther et al.¹⁶ reported that severely injured adolescents experience improved outcomes and decreased invasive procedures without additional mortality risk when treated at PTC. As a result, the authors stated that PTC is an appropriate destination for severely injured adolescents.

Specifically speaking of BSOI, standard management moderately differs between pediatric and adult guidelines. Pediatric guidelines strongly favor nonoperative management in children with BSOI^{17,18}; while adult guidelines make a similar suggestion, operative management rates are significantly higher in adults than in children¹⁹. These disparities in management are not a common concern unless the patient is an adolescent, where the decision is rather split. According to Yung et al.²⁰, despite more than a decade of guidelines supporting nonoperative management, rates of operative intervention in children remain significantly higher in ATC vs. PTC. Similarly, Filipescu et al.²¹ further reassure that PTC significantly outperform ATC in nonoperative management success despite higher splenic injury levels. Operative management in ATC has dropped from 17% to 12.4% in the last decade, but further educational initiatives are needed.

These differences could account for a percentage of the disparities in mortality across trauma centers; though they do not the full extent of this finding²¹. Another study suggested that adolescents with BSOI attended at PTC are less likely to receive blood transfusion within the first hours of admission. Moreover, they were less likely to be admitted to the intensive care unit (ICU) than those treated at ATC. This conservative approach observed within PTC may come at the expense of higher overall adolescent mortality. Analyses showed that mortality was higher among adolescents treated at a PTC with an OR of 2.42 (95% CI; 1.31-4.53). Moreover, after excluding TBI, these differences in outcomes persisted⁹.

Further supporting the aforementioned, Rogers et al.²² conducted a retrospective study about PMT extracted from the Pennsylvania Trauma Outcomes Study database. While no significant difference in mortality was evidenced when comparing different centers, it was reported that adolescents treated at ATC showed improved overall functional status at discharge compared to PTC. Another study performed in Pennsylvania reported higher in-hospital mortality for adolescents treated at ATC; however, these outcomes were not significantly different between PTC and ATC after multivariable regression models. Noteworthy, the authors reported that the only significant difference between ATC and PTC was the need for tomography imaging and emergent laparotomy, which was significantly higher in ATC²³.

Disparities among current evidence is probably a result of different methodologies and patient populations between studies. Moreover, most research on this topic is single-center, with different cut-off points for age strata. Several studies included a significant number of minor injuries, thus, reporting very low mortality and complication rates. These analyses report favorable results regardless of the type of trauma center²⁴⁻²⁶. Nonetheless, recent investigations with solid methodology protocols have been designed to compare adolescent outcomes according to trauma center type. None of the studies showed relevant differences in mortality between center types, with a high level of therapeutic and epidemiological evidence²⁷⁻³³. The above suggests that any survival benefit provided by PTC is age-specific and that adolescents do not fall within this assumption.

Conclusions

MT is the leading cause of death in the pediatric population, including children and adolescents. While international protocols and guidelines have significantly improved mortality and complication rates, there is still room for improvement. In the particular cases of adolescents, decision-making is split between how and where the best options for treatment are. While PTC tend to show rather conservative management of BSOI, they have also shown higher adolescent mortality compared to ATC, suggesting that ATC might be the preferable alternative. However, another significant group of evidence suggests that adolescent mortality does not differ according to the type of trauma center. However, these observations must be taken carefully since available evidence has significant limitations. Most available research encompasses single-center studies, have a low population, and the severity distribution of the injuries is uneven, making the analyses of variables inaccurate. Thus, further research is needed to establish evidence-based strong recommendations on adolescent MT management.

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